

WHAT IS CLAIMED IS:

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1. An image processing device comprising:

a character area extraction part extracting a character area from an original image that is a digital image;

10 a class classification part classifying pixels belonging to said character area into a first class and a second class according to colors;

a black-character-color/ground-color estimation part estimating a black character color and a  
15 ground color on said original image according to the pixels belonging to said character area being classified into said first class and said second class; and

a tone correction part performing a tone correction to said original image according to the  
20 estimated black character color and the estimated ground color.

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2. An image processing device comprising:

a character area extraction part extracting a character area from an original image that is a digital image;

5 a class classification part classifying pixels belonging to said character area into a first class and a second class according to colors;

a background color estimation part estimating a background color on said original image according to  
10 the pixels belonging to said character area being classified into said first class and said second class;

a background area specification part specifying a background area on said original image according to the estimated background color; and

15 a tone correction part performing a tone correction to said original image by replacing a color of the specified background area with the estimated background color.

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3. An image processing device comprising:

a character area extraction part extracting a  
25 character area from an original image that is a digital

image;

a class classification part classifying pixels belonging to said character area into a first class and a second class according to colors;

5 a background color estimation part estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

a background area specification part  
10 specifying a background area on said original image according to the estimated background color; and

a tone correction part performing a tone correction to said original image by replacing a color of the specified background area with a white color.

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4. An image processing device comprising:

20 a feature-value calculation part calculating a feature value with respect to an original image that is a digital image;

a character area extraction part extracting a character area from said original image according to  
25 said feature value;

a block division part dividing said original image into blocks;

a class classification part classifying pixels belonging to said character area in each of said blocks  
5 into a first class and a second class according to colors;

a black-character-color/ground-color estimation part estimating a black character color and a ground color on said original image according to the  
10 pixels belonging to said character area being classified into said first class and said second class; and

a tone correction part performing a tone correction to said original image according to the estimated black character color and the estimated ground  
15 color.

20 5. An image processing device comprising:

a feature-value calculation part calculating a feature value with respect to an original image that is a digital image;

a character area extraction part extracting a  
25 character area from said original image according to

said feature value;

a block division part dividing said original image into blocks;

a class classification part classifying pixels  
5 belonging to said character area in each of said blocks into a first class and a second class according to colors;

a background color estimation part estimating  
a background color on said original image according to  
10 the pixels belonging to said character area being classified into said first class and said second class;

a background area specification part  
specifying a background area on said original image according to the estimated background color; and

15 a tone correction part performing a tone correction to said original image by replacing a color of the specified background area with the estimated background color.

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6. An image processing device comprising:

a feature-value calculation part calculating a  
25 feature value with respect to an original image that is

a digital image;

a character area extraction part extracting a character area from said original image according to said feature value;

5 a block division part dividing said original image into blocks;

a class classification part classifying pixels belonging to said character area in each of said blocks into a first class and a second class according to  
10 colors;

a background color estimation part estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

15 a background area specification part specifying a background area on said original image according to the estimated background color; and

a tone correction part performing a tone correction to said original image by replacing a color  
20 of the specified background area with a white color.

25 7. The image processing device as claimed in

claim 4, wherein said feature-value calculation part calculates an average value and a standard deviation of color signals in a window set around each pixel, and

5       said character area extraction part extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

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8. The image processing device as claimed in claim 5, wherein said feature-value calculation part  
15 calculates an average value and a standard deviation of color signals in a window set around each pixel, and

      said character area extraction part extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in  
20 relation to a threshold value based on said average value and said standard deviation.

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9. The image processing device as claimed in claim 6, wherein said feature-value calculation part calculates an average value and a standard deviation of color signals in a window set around each pixel, and

5           said character area extraction part extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

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10. The image processing device as claimed in claim 4, wherein said feature-value calculation part calculates an edge amount of each pixel, and

          said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said  
20 pixel, as said character area.

25           11. The image processing device as claimed in



claim 5, wherein said feature-value calculation part calculates an edge amount of each pixel, and

5       said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, as said character area.

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12. The image processing device as claimed in claim 6, wherein said feature-value calculation part calculates an edge amount of each pixel, and

15       said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, as said character area.

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13. The image processing device as claimed in claim 4, wherein said feature-value calculation part calculates an edge amount of each pixel and calculates  
25 an average value and a standard deviation of color

signals in a window set around each pixel, and

said character area extraction part extracts a  
pixel having the edge amount equal to or larger than a  
predetermined threshold value, and pixels around said  
5 pixel, as said character area, and extracts a pixel and  
pixels around said pixel as said character area  
according to a color signal value of said pixel in  
relation to a threshold value based on said average  
value and said standard deviation.

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14. The image processing device as claimed in  
15 claim 5, wherein said feature-value calculation part  
calculates an edge amount of each pixel and calculates  
an average value and a standard deviation of color  
signals in a window set around each pixel, and

said character area extraction part extracts a  
20 pixel having the edge amount equal to or larger than a  
predetermined threshold value, and pixels around said  
pixel, as said character area, and extracts a pixel and  
pixels around said pixel as said character area  
according to a color signal value of said pixel in  
25 relation to a threshold value based on said average

value and said standard deviation.

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15. The image processing device as claimed in claim 6, wherein said feature-value calculation part calculates an edge amount of each pixel and calculates an average value and a standard deviation of color signals in a window set around each pixel, and

said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, as said character area, and extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

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16. The image processing device as claimed in claim 4, wherein said class classification part obtains a brightness threshold value based on a brightness

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calculated from color signals of each of the pixels, and  
classifies a group of pixels each having the brightness  
lower than said brightness threshold value into said  
first class, and a group of pixels each having the  
5 brightness higher than said brightness threshold value  
into said second class.

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17. The image processing device as claimed in  
claim 5, wherein said class classification part obtains  
a brightness threshold value based on a brightness  
calculated from color signals of each of the pixels, and  
15 classifies a group of pixels each having the brightness  
lower than said brightness threshold value into said  
first class, and a group of pixels each having the  
brightness higher than said brightness threshold value  
into said second class.

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18. The image processing device as claimed in  
25 claim 6, wherein said class classification part obtains

a brightness threshold value based on a brightness  
calculated from color signals of each of the pixels, and  
classifies a group of pixels each having the brightness  
lower than said brightness threshold value into said  
5 first class, and a group of pixels each having the  
brightness higher than said brightness threshold value  
into said second class.

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19. The image processing device as claimed in  
claim 4, wherein said black-character-color/ground-color  
estimation part estimates an average color of a group of  
15 pixels classified into said first class in one of said  
blocks including a maximum number of pixels classified  
into said second class as the black character color, and  
estimates an average color of a group of said pixels  
classified into said second class as the ground color,  
20 according to a result of said classifying by said class  
classification part in each of said blocks.

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20. The image processing device as claimed in claim 5, wherein said background color estimation part estimates an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class as the background color, according to a result of said classifying by said class classification part in each of said blocks.

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21. The image processing device as claimed in claim 6, wherein said background color estimation part estimates an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class as the background color, according to a result of said classifying by said class classification part in each of said blocks.

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22. The image processing device as claimed in

claim 4, wherein said black-character-color/ground-color estimation part estimates an average color of a group of pixels classified into said first class in one of said blocks including said group of said pixels classified  
5 into said first class and a group of pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, as the black character color, and estimates an average color of said group of said pixels classified into said second  
10 class as the ground color, according to a result of said classifying by said class classification part in each of said blocks.

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23. The image processing device as claimed in claim 5, wherein said background color estimation part estimates an average color of a group of pixels  
20 classified into said second class in one of said blocks including a group of pixels classified into said first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, as the background color,  
25 according to a result of said classifying by said class

classification part in each of said blocks.

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24. The image processing device as claimed in claim 6, wherein said background color estimation part estimates an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, as the background color, according to a result of said classifying by said class classification part in each of said blocks.

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25. The image processing device as claimed in claim 16, wherein said tone correction part performs the tone correction according to a tone conversion curve based on an average value and a standard deviation of brightness in a group of pixels classified into said first class in one of said blocks including a maximum

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number of pixels classified into said second class, and  
on an average value and a standard deviation of  
brightness in a group of said pixels classified into  
said second class, according to a result of said  
5 classifying by said class classification part in each of  
said blocks.

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26. The image processing device as claimed in  
claim 16, wherein said tone correction part performs the  
tone correction according to a tone conversion curve  
based on an average value and a standard deviation of  
15 brightness in a group of pixels classified into said  
first class in one of said blocks including said group  
of said pixels classified into said first class and a  
group of pixels classified into said second class, the  
groups having a maximum difference in average brightness  
20 therebetween, and on an average value and a standard  
deviation of brightness in said group of said pixels  
classified into said second class, according to a result  
of said classifying by said class classification part in  
each of said blocks.

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27. The image processing device as claimed in claim 4, further comprising a low-resolution image generation part generating a low-resolution image having a lower resolution than said original image,

5                wherein said feature-value calculation part calculates the feature value from said low-resolution image, and

                 said character area extraction part extracts said character area from said low-resolution image.

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28. The image processing device as claimed in claim 5, further comprising a low-resolution image generation part generating a low-resolution image having a lower resolution than said original image,

15                wherein said feature-value calculation part calculates the feature value from said low-resolution image, and

20                said character area extraction part extracts said character area from said low-resolution image.

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29. The image processing device as claimed in claim 6, further comprising a low-resolution image generation part generating a low-resolution image having a lower resolution than said original image,

5                wherein said feature-value calculation part calculates the feature value from said low-resolution image, and

                 said character area extraction part extracts said character area from said low-resolution image.

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30. An image processing program interpreted by a computer so as to cause said computer to perform:

                 a character area extraction function of extracting a character area from an original image that is a digital image;

                 a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

                 a black-character-color/ground-color estimation function of estimating a black character color and a ground color on said original image according to the pixels belonging to said character area

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being classified into said first class and said second class; and

5 a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground color.

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31. An image processing program interpreted by a computer so as to cause said computer to perform:

15 a character area extraction function of extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

20 a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

25 a background area specification function of specifying a background area on said original image

according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a color of the specified background area with the

5 estimated background color.

10 32. An image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of extracting a character area from an original image that is a digital image;

15 a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

a background color estimation function of estimating a background color on said original image  
20 according to the pixels belonging to said character area being classified into said first class and said second class;

a background area specification function of specifying a background area on said original image  
25 according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a color of the specified background area with a white color.

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33. An image processing program interpreted  
10 by a computer so as to cause said computer to perform:

a feature-value calculation function of calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of  
15 extracting a character area from said original image according to said feature value;

a block division function of dividing said original image into blocks;

a class classification function of classifying  
20 pixels belonging to said character area in each of said blocks into a first class and a second class according to colors;

a black-character-color/ground-color estimation function of estimating a black character  
25 color and a ground color on said original image

according to the pixels belonging to said character area being classified into said first class and said second class; and

5 a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground color.

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34. An image processing program interpreted by a computer so as to cause said computer to perform:

15 a feature-value calculation function of calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of extracting a character area from said original image according to said feature value;

20 a block division function of dividing said original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according to colors;

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a background color estimation function of  
estimating a background color on said original image  
according to the pixels belonging to said character area  
being classified into said first class and said second  
5 class;

a background area specification function of  
specifying a background area on said original image  
according to the estimated background color; and

a tone correction function of performing a  
10 tone correction to said original image by replacing a  
color of the specified background area with the  
estimated background color.

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35. An image processing program interpreted  
by a computer so as to cause said computer to perform:

a feature-value calculation function of  
20 calculating a feature value with respect to an original  
image that is a digital image;

a character area extraction function of  
extracting a character area from said original image  
according to said feature value;

25 a block division function of dividing said



original image into blocks;

5 a class classification function of classifying  
pixels belonging to said character area in each of said  
blocks into a first class and a second class according  
to colors;

10 a background color estimation function of  
estimating a background color on said original image  
according to the pixels belonging to said character area  
being classified into said first class and said second  
class;

a background area specification function of  
specifying a background area on said original image  
according to the estimated background color; and

15 a tone correction function of performing a  
tone correction to said original image by replacing a  
color of the specified background area with a white  
color.

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36. The image processing program as claimed  
in claim 33, wherein an average value and a standard  
deviation of color signals in a window set around each  
25 pixel are calculated by said feature-value calculation

function, and

a pixel and pixels around said pixel are  
extracted as said character area by said character area  
extraction function according to a color signal value of  
5 said pixel in relation to a threshold value based on  
said average value and said standard deviation.

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37. The image processing program as claimed  
in claim 34, wherein an average value and a standard  
deviation of color signals in a window set around each  
pixel are calculated by said feature-value calculation  
15 function, and

a pixel and pixels around said pixel are  
extracted as said character area by said character area  
extraction function according to a color signal value of  
said pixel in relation to a threshold value based on  
20 said average value and said standard deviation.

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38. The image processing program as claimed

in claim 35, wherein an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

5           a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

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39. The image processing program as claimed  
15 in claim 33, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

          a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels  
20 around said pixel, are extracted as said character area by said character area extraction function.

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40. The image processing program as claimed  
in claim 34, wherein an edge amount of each pixel is  
calculated by said feature-value calculation function,  
and

5           a pixel having the edge amount equal to or  
larger than a predetermined threshold value, and pixels  
around said pixel, are extracted as said character area  
by said character area extraction function.

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41. The image processing program as claimed  
in claim 35, wherein an edge amount of each pixel is  
15           calculated by said feature-value calculation function,  
and

          a pixel having the edge amount equal to or  
larger than a predetermined threshold value, and pixels  
around said pixel, are extracted as said character area  
20           by said character area extraction function.

25           42. The image processing program as claimed

in claim 33, wherein an edge amount of each pixel, and an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

5           a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function, and a pixel and pixels around said pixel are extracted as said  
10 character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

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43. The image processing program as claimed in claim 34, wherein an edge amount of each pixel, and  
20 an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

          a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels  
25 around said pixel, are extracted as said character area

by said character area extraction function, and a pixel  
and pixels around said pixel are extracted as said  
character area by said character area extraction  
function according to a color signal value of said pixel  
5 in relation to a threshold value based on said average  
value and said standard deviation.

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44. The image processing program as claimed  
in claim 35, wherein an edge amount of each pixel, and  
an average value and a standard deviation of color  
signals in a window set around each pixel are calculated  
15 by said feature-value calculation function, and

a pixel having the edge amount equal to or  
larger than a predetermined threshold value, and pixels  
around said pixel, are extracted as said character area  
by said character area extraction function, and a pixel  
20 and pixels around said pixel are extracted as said  
character area by said character area extraction  
function according to a color signal value of said pixel  
in relation to a threshold value based on said average  
value and said standard deviation.

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45. The image processing program as claimed in claim 33, wherein a brightness threshold value is obtained according to a brightness calculated from color signals of each of the pixels by said class  
5 classification function, and a group of pixels each having the brightness lower than said brightness threshold value are classified into said first class, and a group of pixels each having the brightness higher than said brightness threshold value are classified into  
10 said second class by said class classification function.

15 46. The image processing program as claimed in claim 34, wherein a brightness threshold value is obtained according to a brightness calculated from color signals of each of the pixels by said class  
classification function, and a group of pixels each  
20 having the brightness lower than said brightness threshold value are classified into said first class, and a group of pixels each having the brightness higher than said brightness threshold value are classified into  
said second class by said class classification function.

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47. The image processing program as claimed in claim 35, wherein a brightness threshold value is obtained according to a brightness calculated from color signals of each of the pixels by said class  
5 classification function, and a group of pixels each having the brightness lower than said brightness threshold value are classified into said first class, and a group of pixels each having the brightness higher than said brightness threshold value are classified into  
10 said second class by said class classification function.

15 48. The image processing program as claimed in claim 33, wherein an average color of a group of pixels classified into said first class in one of said blocks including a maximum number of pixels classified into said second class is estimated as the black  
20 character color by said black-character-color/ground-color estimation function, and an average color of a group of said pixels classified into said second class is estimated as the ground color by said black-character-color/ground-color estimation function,  
25 according to a result of said classifying by said class



classification function in each of said blocks.

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49. The image processing program as claimed  
in claim 34, wherein an average color of a group of  
pixels classified into said second class in one of said  
blocks including a maximum number of said pixels  
10 classified into said second class is estimated as the  
background color by said background color estimation  
function, according to a result of said classifying by  
said class classification function in each of said  
blocks.

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50. The image processing program as claimed  
20 in claim 35, wherein an average color of a group of  
pixels classified into said second class in one of said  
blocks including a maximum number of said pixels  
classified into said second class is estimated as the  
background color by said background color estimation  
25 function, according to a result of said classifying by

said class classification function in each of said blocks.

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51. The image processing program as claimed in claim 33, wherein an average color of a group of pixels classified into said first class in one of said  
10 blocks including said group of said pixels classified into said first class and a group of pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the black character color by said black-  
15 character-color/ground-color estimation function, and an average color of said group of said pixels classified into said second class is estimated as the ground color by said black-character-color/ground-color estimation function, according to a result of said classifying by  
20 said class classification function in each of said blocks.

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52. The image processing program as claimed in claim 34, wherein an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the background color by said background color estimation function, according to a result of said classifying by said class classification function in each of said blocks.

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53. The image processing program as claimed in claim 35, wherein an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the background color by said background color estimation function, according to a result of said classifying by said class classification function in

each of said blocks.

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54. The image processing program as claimed  
in claim 45, wherein the tone correction is performed by  
said tone correction function according to a tone  
conversion curve based on an average value and a  
10 standard deviation of brightness in a group of pixels  
classified into said first class in one of said blocks  
including a maximum number of pixels classified into  
said second class, and on an average value and a  
standard deviation of brightness in a group of said  
15 pixels classified into said second class, according to a  
result of said classifying by said class classification  
function in each of said blocks.

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55. The image processing program as claimed  
in claim 45, wherein the tone correction is performed by  
said tone correction function according to a tone  
25 conversion curve based on an average value and a

standard deviation of brightness in a group of pixels  
classified into said first class in one of said blocks  
including said group of said pixels classified into said  
first class and a group of pixels classified into said  
5 second class, the groups having a maximum difference in  
average brightness therebetween, and on an average value  
and a standard deviation of brightness in said group of  
said pixels classified into said second class, according  
to a result of said classifying by said class  
10 classification function in each of said blocks.

15                56. The image processing program as claimed  
in claim 33, further causing said computer to perform a  
low-resolution image generation function of generating a  
low-resolution image having a lower resolution than said  
original image,

20                wherein the feature value is calculated from  
said low-resolution image by said feature-value  
calculation function, and

                 said character area is extracted from said  
low-resolution image by said character area extraction  
25 function.

57. The image processing program as claimed  
in claim 34, further causing said computer to perform a  
low-resolution image generation function of generating a  
low-resolution image having a lower resolution than said  
5 original image,

wherein the feature value is calculated from  
said low-resolution image by said feature-value  
calculation function, and

said character area is extracted from said  
10 low-resolution image by said character area extraction  
function.

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58. The image processing program as claimed  
in claim 35, further causing said computer to perform a  
low-resolution image generation function of generating a  
low-resolution image having a lower resolution than said  
20 original image,

wherein the feature value is calculated from  
said low-resolution image by said feature-value  
calculation function, and

said character area is extracted from said  
25 low-resolution image by said character area extraction

function.

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59. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of  
10 extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

15 a black-character-color/ground-color estimation function of estimating a black character color and a ground color on said original image according to the pixels belonging to said character area being classified into said first class and said second  
20 class; and

a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground color.

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60. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of  
5 extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

10 a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

15 a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a  
20 color of the specified background area with the estimated background color.



61. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of  
5 extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

10 a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

15 a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a  
20 color of the specified background area with a white color.

62. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a feature-value calculation function of  
5 calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of extracting a character area from said original image according to said feature value;

10 a block division function of dividing said original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according  
15 to colors;

a black-character-color/ground-color estimation function of estimating a black character color and a ground color on said original image according to the pixels belonging to said character area  
20 being classified into said first class and said second class; and

a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground  
25 color.

63. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a feature-value calculation function of  
5 calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of extracting a character area from said original image according to said feature value;

10 a block division function of dividing said original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according  
15 to colors;

a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second  
20 class;

a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a  
25 tone correction to said original image by replacing a

color of the specified background area with the estimated background color.

5

64. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

10       a feature-value calculation function of calculating a feature value with respect to an original image that is a digital image;

          a character area extraction function of extracting a character area from said original image  
15 according to said feature value;

          a block division function of dividing said original image into blocks;

          a class classification function of classifying pixels belonging to said character area in each of said  
20 blocks into a first class and a second class according to colors;

          a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area  
25 being classified into said first class and said second

class;

a background area specification function of specifying a background area on said original image according to the estimated background color; and

5 a tone correction function of performing a tone correction to said original image by replacing a color of the specified background area with a white color.

10

65. The computer readable recording medium as claimed in claim 62, wherein an average value and a  
15 standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

a pixel and pixels around said pixel are extracted as said character area by said character area  
20 extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

25

66. The computer readable recording medium as claimed in claim 63, wherein an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

67. The computer readable recording medium as claimed in claim 64, wherein an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

68. The computer readable recording medium as claimed in claim 62, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

5           a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function.

10

69. The computer readable recording medium as claimed in claim 63, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

15           a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area  
20 by said character area extraction function.

25           70. The computer readable recording medium as

claimed in claim 64, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

5 a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function.

10

71. The computer readable recording medium as claimed in claim 62, wherein an edge amount of each pixel, and an average value and a standard deviation of  
15 color signals in a window set around each pixel are calculated by said feature-value calculation function, and

a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels  
20 around said pixel, are extracted as said character area by said character area extraction function, and a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel  
25 in relation to a threshold value based on said average



value and said standard deviation.

5

72. The computer readable recording medium as claimed in claim 63, wherein an edge amount of each pixel, and an average value and a standard deviation of color signals in a window set around each pixel are  
10 calculated by said feature-value calculation function, and

a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area  
15 by said character area extraction function, and a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average  
20 value and said standard deviation.

25

73. The computer readable recording medium as

claimed in claim 64, wherein an edge amount of each  
pixel, and an average value and a standard deviation of  
color signals in a window set around each pixel are  
calculated by said feature-value calculation function,  
5 and

a pixel having the edge amount equal to or  
larger than a predetermined threshold value, and pixels  
around said pixel, are extracted as said character area  
by said character area extraction function, and a pixel  
10 and pixels around said pixel are extracted as said  
character area by said character area extraction  
function according to a color signal value of said pixel  
in relation to a threshold value based on said average  
value and said standard deviation.

15

74. The computer readable recording medium as  
20 claimed in claim 62, wherein a brightness threshold  
value is obtained according to a brightness calculated  
from color signals of each of the pixels by said class  
classification function, and a group of pixels each  
having the brightness lower than said brightness  
25 threshold value are classified into said first class,

and a group of pixels each having the brightness higher than said brightness threshold value are classified into said second class by said class classification function.

5

75. The computer readable recording medium as claimed in claim 63, wherein a brightness threshold  
10 value is obtained according to a brightness calculated from color signals of each of the pixels by said class classification function, and a group of pixels each having the brightness lower than said brightness  
threshold value are classified into said first class,  
15 and a group of pixels each having the brightness higher than said brightness threshold value are classified into said second class by said class classification function.

20

76. The computer readable recording medium as claimed in claim 64, wherein a brightness threshold  
value is obtained according to a brightness calculated  
25 from color signals of each of the pixels by said class

classification function, and a group of pixels each  
having the brightness lower than said brightness  
threshold value are classified into said first class,  
and a group of pixels each having the brightness higher  
5 than said brightness threshold value are classified into  
said second class by said class classification function.

10

77. The computer readable recording medium as  
claimed in claim 62, wherein an average color of a group  
of pixels classified into said first class in one of  
said blocks including a maximum number of pixels  
15 classified into said second class is estimated as the  
black character color by said black-character-  
color/ground-color estimation function, and an average  
color of a group of said pixels classified into said  
second class is estimated as the ground color by said  
20 black-character-color/ground-color estimation function,  
according to a result of said classifying by said class  
classification function in each of said blocks.

25

78. The computer readable recording medium as claimed in claim 63, wherein an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels  
5 classified into said second class is estimated as the background color by said background color estimation function, according to a result of said classifying by said class classification function in each of said blocks.

10

79. The computer readable recording medium as  
15 claimed in claim 64, wherein an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class is estimated as the background color by said background color estimation  
20 function, according to a result of said classifying by said class classification function in each of said blocks.

25

80. The computer readable recording medium as claimed in claim 62, wherein an average color of a group of pixels classified into said first class in one of said blocks including said group of said pixels  
5 classified into said first class and a group of pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the black character color by said black-character-color/ground-color estimation function, and an  
10 average color of said group of said pixels classified into said second class is estimated as the ground color by said black-character-color/ground-color estimation function, according to a result of said classifying by said class classification function in each of said  
15 blocks.

20 81. The computer readable recording medium as claimed in claim 63, wherein an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said first class and said group of said pixels  
25 classified into said second class, the groups having a

maximum difference in average brightness therebetween,  
is estimated as the background color by said background  
color estimation function, according to a result of said  
classifying by said class classification function in  
5 each of said blocks.

10                   82. The computer readable recording medium as  
claimed in claim 64, wherein an average color of a group  
of pixels classified into said second class in one of  
said blocks including a group of pixels classified into  
said first class and said group of said pixels  
15 classified into said second class, the groups having a  
maximum difference in average brightness therebetween,  
is estimated as the background color by said background  
color estimation function, according to a result of said  
classifying by said class classification function in  
20 each of said blocks.

25                   83. The computer readable recording medium as

claimed in claim 74, wherein the tone correction is performed by said tone correction function according to a tone conversion curve based on an average value and a standard deviation of brightness in a group of pixels  
5 classified into said first class in one of said blocks including a maximum number of pixels classified into said second class, and on an average value and a standard deviation of brightness in a group of said pixels classified into said second class, according to a  
10 result of said classifying by said class classification function in each of said blocks.

15

84. The computer readable recording medium as claimed in claim 74, wherein the tone correction is performed by said tone correction function according to a tone conversion curve based on an average value and a  
20 standard deviation of brightness in a group of pixels classified into said first class in one of said blocks including said group of said pixels classified into said first class and a group of pixels classified into said second class, the groups having a maximum difference in  
25 average brightness therebetween, and on an average value



and a standard deviation of brightness in said group of  
said pixels classified into said second class, according  
to a result of said classifying by said class  
classification function in each of said blocks.

5

85. The computer readable recording medium as  
10 claimed in claim 62, wherein the image processing  
program further causes said computer to perform a low-  
resolution image generation function of generating a  
low-resolution image having a lower resolution than said  
original image,

15 wherein the feature value is calculated from  
said low-resolution image by said feature-value  
calculation function, and

said character area is extracted from said  
low-resolution image by said character area extraction  
20 function.

25 86. The computer readable recording medium as

claimed in claim 63, wherein the image processing  
program further causes said computer to perform a low-  
resolution image generation function of generating a  
low-resolution image having a lower resolution than said  
5 original image,

wherein the feature value is calculated from  
said low-resolution image by said feature-value  
calculation function, and

said character area is extracted from said  
10 low-resolution image by said character area extraction  
function.

15

87. The computer readable recording medium as  
claimed in claim 64, wherein the image processing  
program further causes said computer to perform a low-  
resolution image generation function of generating a  
20 low-resolution image having a lower resolution than said  
original image,

wherein the feature value is calculated from  
said low-resolution image by said feature-value  
calculation function, and

25 said character area is extracted from said

low-resolution image by said character area extraction function.